

A new bio-inspired route to prepare silver nanoparticle-based heterogeneous catalysts

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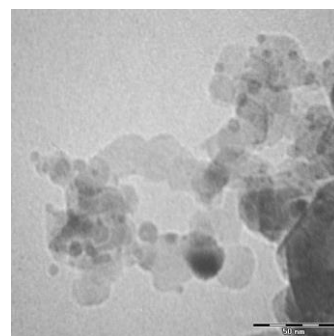
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Chemical reactions often require metal-based catalysts which usually demand small and stable metal particles.^[1] However, classical preparation methods often imply a thermal treatment during which sintering phenomena are hardly controlled. Onion-type multilamellar vesicles (MLVs), mainly known for their potential applications in biotechnology, can be used for the spontaneous and controlled production of metal nanoparticles. This process has the advantage of not requiring any thermal treatment.

The possibility to use preformed and tailored nanoparticles formed through this bio-inspired route for the preparation of metal nanoparticle-based catalysts is presented here. This innovative concept^[2] takes advantage of the expertise in nanobiotechnology to answer issues encountered in the field of inorganic catalysis.

The synthesis of silver nanoparticles inside MLVs was performed spontaneously at room temperature using the surfactant itself (Genamin T020) as the reductant. No thermal, chemical or electrochemical treatment was applied. Silver nanoparticle-loaded MLVs were quantitatively transferred onto a TiO₂ support and a V₂O₅/TiO₂ catalyst, as attested by TEM images, XPS and ICP-AES analysis. The method (impregnation of a colloidal suspension, evaporation under vacuum and drying) did not involve any separation of the organic matter, which only accounts for ~5% of the final mass of the fresh catalyst.

In order to validate this new preparation method, the materials were tested in the total oxidation of benzene, chosen as a model for industrial and domestic air pollutants. We evidence the activity of the Ag nanoparticles on TiO₂. A synergetic effect between the V-based catalyst and the added silver nanoparticles is also described. We finally show that small nanoparticles (~5 nm) survive relatively high temperature. A protection mechanism (vs. sintering) involving the surfactant is proposed.



[1] Haruta, M. *Cattech*, 6 (2002) 102

[2] Debecker, D.P., Faure, C., Meyre, M.-E., Derré, A., Gaigneaux, E.M., *Small*, 10 (2008) 1806